KELP: K2 observations of Evolving Low-mass stars and their Planets
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M dwarf stars are attractive targets for searches for Earth-like and potentially habitable exoplanets because their small size permits the detection of Earth-size planets on close-in orbits, and their low luminosity means that such planets may orbit within the habitable zone where surface liquid water can be stable. Such stars are overrepresented among the host stars of planets, especially those small planets with moderate equilibrium temperatures, detected by the Kepler mission. However, the possible dynamical and physical evolution of planets in the compact habitable zones around M dwarfs is poorly understood. Because such stars evolve slowly after reaching the main sequence, it is difficult to assign ages to M dwarf planet systems and investigate changes with time. M dwarfs in coeval moving groups of known age can be studied, and the rotation and activity of those stars used to construct a gyrochronology to assign ages to other M dwarfs in the field.   We propose K2 observations of 2121 M dwarf stars in the Campaign 4 and 5 fields that are confirmed or candidate members of the Pleiades, Hyades, and Praesepe clusters. The members of these clusters have ages of about 120, 650, and 600 Myr, respectively. We include candidates in the Ecliptic Plane Input Catalog identified as M dwarfs in the recent published literature, as well as stars with matching colors and magnitudes, and proper motions permissive of the stars being dwarfs. We propose long cadence observations to identify candidate transiting planets on short-period orbits and determine the stellar rotational periods in the resulting light curves. We will carry out a vigorous campaign of ground-based observations to estimate the fundamental stellar parameters (effective temperature, metallicity, radius, luminosity, and mass) of these stars and use comparisons with a stellar evolution model, and estimates of distance, age, and radial velocity to assess the likelihood of membership of each star in any of the clusters. We will use archival ultraviolet and X-ray observations from space mission to determine the high-energy radiation from these stars, and propose additional X-ray observations if appropriate. We will use the rotation periods of these stars as obtained by K2 to construct an improved M dwarf gyrochronology with which we can assign ages to other, field M dwarfs and expand an investigation of the evolution of these stars and their planetary systems with time.